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that you will receive the work kindly, and tell me of its fate as soon as you can.

How far advanced is the Magnetic Survey of India? Could not you get travellers to observe in Egypt, Nubia, Mesopotamia and Persia? In the Pacific we want observations, especially on Erman's route: the number of facts known is too small for good inferences: we want tests for Duperrey's and Freycinet's Dips, which at neighbouring points differ  $3^{\circ}$  or  $4^{\circ}$ . Of Elliot's I know only the results taken from the Proceedings of the Royal Society; Kupffer has, I see, a copy of the work itself from the Phil. Trans. Has not Rae made observations on his journeys, and is anything printed? the same question as to all the expeditions in search of Franklin?

(Signed)

L. M. KÄMTZ.

April 28, 1853

The EARL OF ROSSE, President, in the Chair.

A paper was read, entitled "On the Application of the Law of the Conservation of Energy to the Determination of the Magnetic Meridian on board Ship, when out of reach or out of sight of Land." By W. J. Macquorn Rankine. Communicated by Colonel Sabine, R.A., Treas., V.P.R.S. &c. Received April 5, 1853.

The author states that, assuming that when a ship is swung completely round, so that her head bears exactly as it did at first, the magnetism of the ship, and that of the compass-needle return to their original condition, the following theorem is necessarily true:—

*The mechanical power developed by the mutual action of the ship and of the compass-needle during a complete revolution of the ship, is equal to zero.*

If  $\zeta'$  be the apparent magnetic azimuth of the ship's head, east of north;  $\alpha'$  the corresponding apparent magnetic azimuth of a distant fixed terrestrial object (or where no such object is visible, of a star, corrected by calculation for its apparent diurnal motion);  $\alpha$  the true magnetic azimuth of the same object, so that  $\alpha - \alpha'$  is the westerly deviation of the compass-needle; then the above theorem is expressed symbolically thus:—

$$0 = \int_0^{2\pi} \sin(\alpha - \alpha') \cdot d\zeta' = \sin \alpha \int_0^{2\pi} \cos \alpha' \cdot d\zeta' - \cos \alpha \int_0^{2\pi} \sin \alpha' \cdot d\zeta';$$

from which it follows that

$$\tan \alpha = \frac{\int_0^{2\pi} \sin \alpha' \cdot d\zeta'}{\int_0^{2\pi} \cos \alpha' \cdot d\zeta'}.$$

The author remarks, that for the integrals in this formula are to be substituted, in practice, the algebraical sums of the sines and

cosines respectively, of the apparent magnetic bearings of the distant object, observed with the ship's head successively on the sixteen principal points of the compass (or on eight principal points, as the case may be). He considers that this method may prove useful in magnetic surveys of the ocean.

Additional remarks to the foregoing paper. Received April 14, 1853.

In consequence of a suggestion of Professor William Thomson, the author here investigates the modifications required in the formulæ of the previous part of his paper, when the compass-needle produces by induction a sensible effect on the mutual magnetic action of the earth and the ship.

Let  $A$ , as in Mr. Archibald Smith's formulæ, represent the mean of the sines of the deviations of the compass-needle observed during a complete revolution of the ship. As there is reason to believe that this quantity does not vary for a given ship in different parts of the earth so long as the quantity and distribution of her iron are unchanged, it may be determined, once for all, while in port, in the usual way.

When the ship is out of reach of land, let  $s$  be the mean of the sines, and  $c$  the mean of the cosines, of the apparent magnetic azimuths of a distant object observed during a complete revolution of the ship. Then the sine of the true magnetic azimuth of the object is given by the formula

$$\sin \alpha = \frac{s \sqrt{(c^2 + s^2 - A^2)} - cA}{c^2 + s^2}.$$

When  $A=0$ , this formula becomes

$$\tan \alpha = \frac{s}{c},$$

being identical with that of the previous part of this paper.

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May 12, 1853.

The EARL OF ROSSE, President, in the Chair.

In compliance with the Statutes, it was announced from the Chair, that the following Candidates are recommended by the Council for election into the Society:—

James Apjohn, M.D.  
John George Appold, Esq.  
John Allan Broun, Esq.  
Antoine Jean François Claudet,  
Esq.  
Edward J. Cooper, Esq.  
E. Frankland, Esq.  
John Hall Gladstone, Esq.  
Joseph Beete Jukes, Esq.

Robert MacAndrew, Esq.  
Charles Manby, Esq.  
Joseph Prestwich, Esq.  
William John Macquorn Rankine, Esq.  
William Wilson Saunders, Esq.  
William Spottiswoode, Esq.  
Count P. de Strzelecki.